NASA STTR 2014 Phase I Solicitation

T11.01 Information Technologies for Intelligent and Adaptive Space Robotics

Lead Center: ARC

Participating Center(s): JPL, JSC

The objective of this subtopic is to develop information technologies that enable robots to better support space exploration. Robots are already at work in all of NASA's Mission Directorates and will be critical to the success of future exploration missions. The NASA “Robotics, Tele-Robotics, and Autonomous Systems” roadmap (TA04) indicates that extensive and pervasive use of robots can significantly enhance exploration, particularly for missions that are progressively longer, complex, and operate with fewer ground control resources.

Intelligent robots can do a variety of work to increase the productivity of planetary exploration. Robots can perform tasks that are highly-repetitive, long-duration, or tedious. Robots can perform tasks that help prepare for subsequent human missions. Robots can perform "follow-up" work, completing tasks started by astronauts. Example robotic tasks include: scouting, site surveys, sampling, payload deployment and unskilled labor (site clean-up, close-out tasks, etc).

The performance of intelligent robots is directly linked to the quality and capability of the information technologies used to build and operate them. Thus, proposals are sought that address the following technology needs:

- Advanced user interfaces for shared-autonomy and remotely operated robots, which facilitate distributed collaboration, geospatial data visualization, summarization and notification, and robot tasking. This does NOT include user interfaces for direct teleoperation / purely manual control (e.g., joystick-based rate control), telepresence, or immersive virtual reality. The primary objective is to enable more effective and efficient interaction with semi-autonomous telerobots.
- Mobile robot navigation (localization, hazard avoidance, etc.) for operations in man-made (inside human spacecraft) and unstructured environments (planetary surfaces). Emphasis on multi-sensor data fusion, obstacle detection, and proximity ops. The primary objective is to radically and significantly increase the performance of mobile robot navigation through advanced on-board sensors, perception algorithms and software.
- Robot software architecture that radically reduces operator workload for remotely operating mobile robots. This includes frameworks for adjustable autonomy, on-board health management and prognostics, automated data triage, and high-performance robot middleware. The primary objective is to facilitate the creation, extensibility and maintenance of complex robot systems.

Deliverables to NASA:

- Identify scenarios and use cases.
- Define specifications based on design trades.
- Develop concepts to address use cases.

- Demonstrate prototype systems and technology demonstrations.